2178130

(12) UK Patent Application (19) GB (11) 2 266 322 (13) A

(43) Date of A publication 27.10.1993

(21) Application No 9306168.7

(22) Date of filing 25.03.1993

(30) Priority data
(31) 9206623 (32) 26.03.1992 (33) GB

(71) Applicant
Don & Low (Holdings) Limited

(Incorporated in the United Kingdom)

St. James Road, Forfar, Angus, DD8 2AL, United Kingdom

(72) Inventors
Andrew Nicholas Ferrar
William Henderson

(74) Agent and/or Address for Service
Cruikshank & Fairweather
19 Royal Exchange Square, Glasgow, G1 3AE, United Kingdom

(51) INT CL[5]
D04C 1/12, D02G 3/04, D04G 1/00, D07B 1/00 // D04C 1/02

(52) UK CL (Edition L)
D1K K11 K14
D1T T1B T1H T1M
D1W W7A W7B W7C
U1S S1022 S1586

(56) Documents cited
GB 1541032 A GB 0699579 A GB 0600424 A
EP 0049196 A1 WO 91/11324 A1 US 4378725 A

(58) Field of search
UK CL (Edition L) D1K, D1T, D1W
INT CL[5] D02G, D04C, D04G, D07B

(54) Thermoplastic composite material

(57) A thermoplastic composite is formed of a plurality of elongate elements (14) which may be braided together, each element comprising a thermoplastic polymer base having at least one thermoplastic surface polymeric layer bonded to the polymer base. The surface layer has a softening temperature lower than that of the polymer and, at least at the outer surface of the composite, the surface layer of each element is fused with the surface layer of adjacent elements to provide a sealed structure. The composite may be in the form of a yarn, tape, cord (10), string, rope, twine or the like, and may be arranged in the form of a desired structure; for example the elements may have been braided into a suitable yarn and then knotted into a net structure, eg a fishing net.

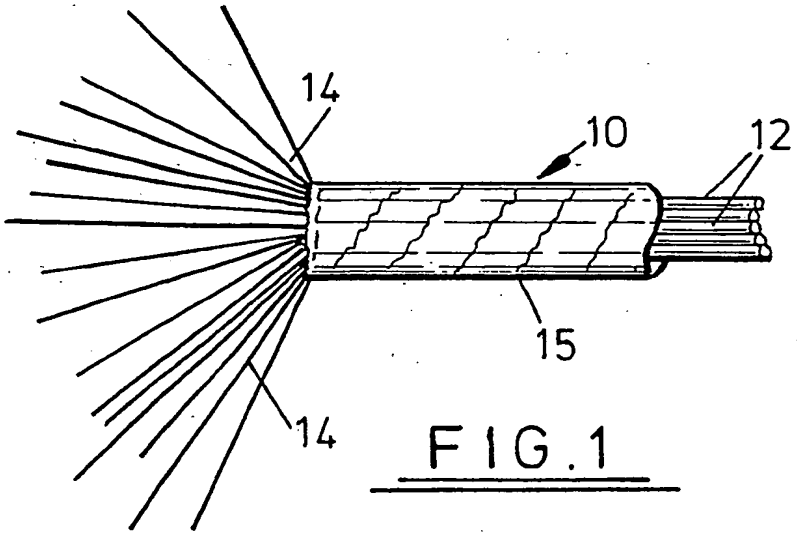

FIG.1

GB 2 266 322 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

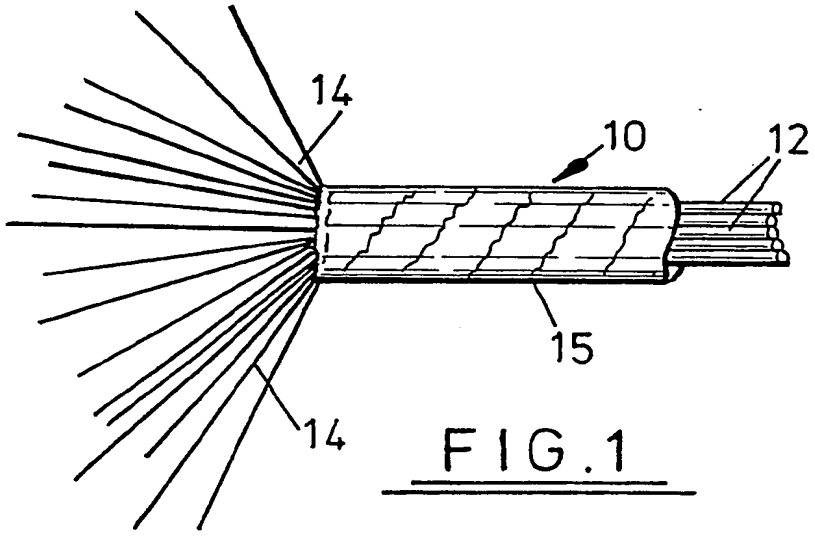

FIG.1

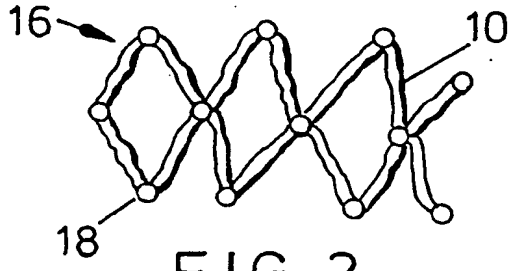

FIG.2

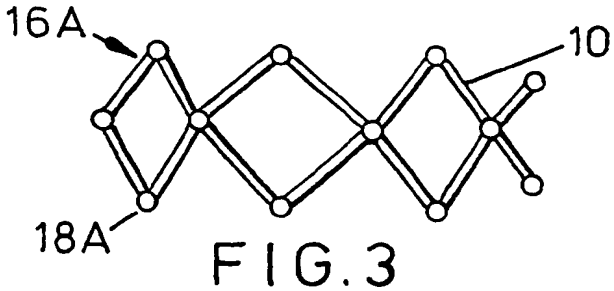

FIG.3

IMPROVEMENTS IN OR RELATING TO A THERMOPLASTIC COMPOSITE MATERIAL

This invention relates to a thermoplastic composite material and a method of its production. The composite material is particularly suited for applications requiring mechanical strength combined with abrasion resistance. Such applications include, by way of example, sea trawling fishing nets, brick covering meshes for retention of goods during transport and rock climbing accessories such as ropes, tapes and harnesses.

Fishing nets are typically constructed from braided polypropylene, polyethylene or nylon yarn which is knotted to produce the net structure. The requirement to withstand abrasion from sand and grit encountered by the net has resulted in polyethylene being the preferred material for use in forming such nets, whereas materials such as polypropylene, with relatively poor abrasion resistance, tend not to be used.

During use of braided nets, grit and sand tend to become embedded in the open braid structure and fill the hollow centre of the braid adding weight to the net, closing the mesh and generally abrading the yarn. This results in yarn elements becoming broken or frayed and the nets soon becomes unserviceable, damaging fish and operator's skin.

It is an object of the present invention to provide a composite which is resistant to abrasion and avoids the disadvantages associated with migration of sand and grit into braided materials.

According to one aspect of the present invention there is provided a thermoplastic composite formed of a plurality of interwoven elongate elements, each of said elements comprising a thermoplastic polymer base having at least one thermoplastic surface polymeric layer bonded to said polymer base, and said surface polymeric layer having a softening temperature lower than that of the polymer and, at least at the outer surface of the composite, the surface polymeric layer of each element being fused with the surface polymeric layer of adjacent elements to provide a sealed structure.

The composite is preferably in the form of a yarn, tape, cord, string, rope, twine or the like, and may be arranged in the form of a desired structure, for example the elements may have been braided into a suitable yarn and then knotted into a net structure.

The composite is particularly suited for applications in which the composite will be exposed to grit, dirt and sand: the fused polymeric layers prevent ingress of abrasive material into the composite which would otherwise fill the spaces between the elements adding weight to the composite, closing the mesh and abrading the elements. Accordingly, the composite is ideally suited for use in

forming fishing nets and items such as climbing and construction ropes, tapes and harnesses.

The composite may include elongate core elements around which the elongate elements may be woven.

Preferably, the surface polymeric layer of each element is compatibly bonded to said respective polymer base by molecular interspersion between the contiguous surfaces of the adjoining base and surface layers, in a similar manner to that described in our International Patent Application No. PCT/GB91/00132 as published on 8 August 1991 under International Publication No. WO91/11324.

By "molecular interspersion" is meant the intimate molecular compatibility of molecules of the surface layer and the adjacent polymer base and vice versa so that there is intermingling or fusion at their contiguous boundaries. It is believed that such molecular interspersion effectively forms an amorphous sheath which protects the polymer base against fracture during drawing thus providing mutual mechanical reinforcement.

Mutual mechanical reinforcement involves the surface material being capable of high elongation when drawn in the solid state (or even being drawn at a temperature above its softening point, i.e. in the molten state). The preferred draw ratio of the elements is 5 to 20. With a polymer layer of high modulus, crystalline or oriented material sandwiched between amorphous high elongation surface layers, propagation of transverse fractures is

inhibited allowing the total composite to be highly drawn.

Preferably, the polymer base is a polyolefin polymer such as polypropylene, a polyester such as polyethyleneterephthalate, a polyamide such as Nylon 6 or 6.6, or a polyethylene having a density in the range 0.940 to 0.970 or linear low density polyethylene.

Preferably also, when the polymer base is polypropylene each surface layer is an ethylene-propylene co-polymer, a polybutylene such as polybutene-1, or a co-polymer comprising two or more of butylene, ethylene and propylene. When the polymer base is a polyester, the surface layers can be a co-polyester and when the polymer base is a polyamide can be a co-polyamide.

The composite may thus utilise a material such as polypropylene to form the protected base with a polyethylene surface layer thus overcoming any disadvantages arising from the relatively poor abrasion resistance of polypropylene and with regard to fishing nets allowing utilisation of the improved buoyancy characteristics of polypropylene. Differential selection of the materials may permit the production of, for example, an upper net portion of greater buoyancy such that the net remains upright in use.

According to another aspect of the present invention there is provided a method of producing a thermoplastic composite material comprising the steps:

providing a plurality of elongate elements each

comprising a thermoplastic polymer base having at least one thermoplastic surface polymeric layer bonded to said polymer base, and said surface polymeric layer having a softening temperature lower than that of the polymer base;

braiding the elongate elements together;

heating the braided elements to a temperature at or above the softening temperature of each surface polymeric layer but below the softening temperature of the polymeric base; and

cooling the braided elements causing the elongate elements to fuse together to provide a sealed structure.

The elements may be braided together by weaving, spinning, twisting and the like to form a yarn, tape, cord, string, rope or the like. Prior to heating the elements may further be arranged into a desired form, for example braided into a suitable yarn and then knotted into a net structure. In a composite with a polypropylene base and a polyethylene surface layer the net structure may be autoclaved at 130 - 135^{o}C for several minutes to heat set the polyethylene. Of course the selected temperature fusing or bonding temperature, and the bond characteristics will vary depending on the choice of polymers, the thickness of the softening layer and the degree of continuity of contact during the bond cycle.

Preferably, pressure or tension is applied to the braided elements during fusing to assist in achieving a high order of surface contact and improved bonding.

The degree of fusing may be varied over the lengths of the braided elements to provide areas of different flexibility or drape.

One embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows the forming of a thermoplastic composite material, in the form of a cord, in accordance with an embodiment of the present invention;

Figure 2 shows a net structure formed of the cord of Figure 1; and

Figure 3 shows the net structure of Figure 2 after heat treatment.

Reference is first made to Figure 1 of the drawings, which shows the braiding of a 4 mm diameter cord 10 for ultimately forming part of a net structure. The cord 10 comprises eight core elements 12 around which a multiplicity of individual tape-like elements 14 is braided to form a braided cap 15. The elements 14 are of ethylene propylene formed from a coextrusion slit film process and oriented to provide tensile characteristics. In this example the tape count chosen was 44 tex, but any count could be utilised, within reason, and eighty elements 14 were utilised. The number of elements 14 incorporated in the braid may be varied widely and will be determined by end use and machinery limitations.

The core elements 12 contribute to the strength and

stability of the cord 10, and after knotting into a mesh structure 16, as shown in Figure 2 of the drawings, the core elements 12 are compressed and held tightly at the knotted portions 18 of the cord 10.

The mesh structure 16 as initially formed is relatively loose and unstable. However, the structure 16 is then subject to heat treatment in an autoclave by heating to 125 - 135°C for approximately 20 minutes, which stabilises the cord structure, shrinks the knots 18A and tightens the mesh 16A, as shown in Figure 3 of the drawings.

It will be clear to those of skill in the art that the above described embodiment represents only one example of the present invention, and that various modifications and improvements may be carried out to the composite structure described without departing from the scope of the present invention.

CLAIMS

1. A thermoplastic composite formed of a plurality of interwoven elongate elements, each of said elements comprising a thermoplastic polymer base having at least one thermoplastic surface polymeric layer bonded to said polymer base, and said surface polymeric layer having a softening temperature lower than that of the polymer and, at least at the outer surface of the composite, the surface polymeric layer of each element being fused with the surface polymeric layer of adjacent elements to provide a sealed structure.

2. A composite as claimed in claim 1 in which the composite is in the form of a yarn, tape, cord, string rope, twine or the like.

3. A composite as claimed in claim 2 in which the elements are braided into a yarn and knotted into a net structure.

4. A composite as claimed in claim 1, 2 or 3 including elongate core elements around which the elongate elements are woven.

5. A composite as claimed in claim 1, 2, 3 or 4 in which

the surface polymeric layer of each element is compatibly bonded to said respective polymer base by molecular interspertion.

6. A composite as claimed in any one of the preceding claims in which the polymer base is one of a polyolefin polymer, a polyester, a polyamide, a polyethylene having a density in the range 0.940 to 0.970, or linear low density polyethylene.

7. A composite as claimed in claim 6 in which the polymer base is polypropylene, and each surface layer is one of an ethylene-propylene co-polymer, a polybutylene, or a co-polymer comprising two or more of butylene, ethylene and propylene.

8. A composite as claimed in claim 6 in which the polymer base is a polyester and each surface layer is a co-polyester.

9. A composite as claimed in claim 6 in which the polymer base is a polyamide or a co-polymide.

10. A method of producing a thermoplastic composite material comprising the steps:

providing a plurality of elongate elements each comprising a thermoplastic polymer base having at least

one thermoplastic surface polymeric layer bonded to said polymer base, and said surface polymeric layer having a softening temperature lower than that of the polymer base;

braiding the elongate elements together;

heating the braided elements to a temperature at or above the softening temperature of each surface polymeric layer but below the softening temperature of the polymeric base; and

cooling the braided elements causing the elongate elements to fuse together to provide a sealed structure.

11. The method of claim 10 in which the elements are braided together by weaving, spinning, twisting and the like to form a yarn, tape, cord, string, rope or the like.

12. The method of claim 10 or 11, in which the braided elements are arranged into a desired structure prior to heating.

13. The method of claim 12, in which the braided elements are knotted into a net structure prior to heating.

14. The method of claim 11, 12 or 13, in which the composite has a polypropylene base and a polyethylene surface layer and is autoclaved to heat set the polyethylene.

15. The method of any one of claims 11 to 14, in which pressure or tension is applied to the braided elements during fusing to assist in achieving a high order of surface contact and improved bonding.

16. The method of any one of claim 11 to 15, in which the degree of fusing is varied over the lengths of the braided elements to provide areas of different flexibility or drape.

17. A method of producing a thermoplastic composite material substantially as described herein and as illustrated in the accompanying drawings.

18. A thermoplastic composite substantially as described herein and as illustrated in the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
GB 9306168.7

Relevant Technical fields

(i) UK Cl (Edition L) D1K; D1T; D1W

(ii) Int Cl (Edition 5) D02G; D04C; D04G; D07B

Search Examiner
ALEX LITTLEJOHN

Databases (see over)
(i) UK Patent Office

(ii)

Date of Search
19 JULY 1993

Documents considered relevant following a search in respect of claims 1-18

Category (see over)	Identity of document and relevant passages		Relevant to claim(s)
X	GB 1541032	(UBE NITTO) - see whole document, eg page 4 lines 70-113	1, 2, 6, 9, 10, 11, 15
X	GB 699579	(HEMINWAY) - see whole document, eg page 4 lines 1-18 and Figure 2	1-3, 6, 9-13, 15
X	GB 600424	(TELEGRAPH) - see whole document, eg page 1 lines 44-55	1, 2, 10, 11, 15
X	EP 0049196 A1	(COUSIN) - see whole document, eg page 6 lines 18-37	1, 2, 6, 9, 10, 11, 15
X,Y	US 4378725	(HOSPERS) - see whole document, eg column 4 lines 7-10, 22-50	X: 1-6, 9-13 Y: 7, 8, 14
Y	WO 91/11324 A1	(DON & LOW) - see whole document	7, 8, 14

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

SDOCID: <GB 2266322A_I_>